Asterix

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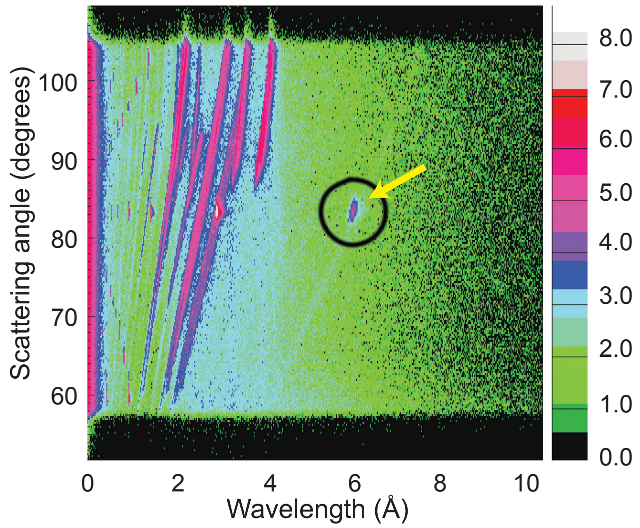
instruments

The development of neutron spin and sample excitation correlation techniques is essential for understanding a wide range of magnetic and related electron transport problems in the emerging class of complex materials, including, for example, nanostructure-engineered and adaptive materials. A detailed understanding of complex materials requires studies that use neutron beams to characterize the exotic magnetic and atomic and structures of these materials under extreme conditions of high-magnetic fields, high pressures, and very low temperatures. The first objective of this project was to understand the complex instrumentation issues involved in extracting a polarized neutron beam from a pulsed neutron source and propagating the beam through magnetic field gradients that vary in space and time. A second objective is to develop a solution to the polarization problems, e.g., beam splitting (the Stern-Gerlach effect) associated with interactions between (polarized) neutron beams and the equipment (in this case the high-field magnets) used to produce a variety of extreme environments simultaneously. The solution of this problem enables unique studies of complex materials.

View of the 11-T Oxford superconducting magnet. To the right of the magnet is the Asterix two-dimensional position-sensitive detector (PSD) array. Between the magnet and the detector, we installed borated polyethylene shields, which helps reduce neutron background by one order of magnitude.

Asterix Specifications	
Moderator	Lower-tier coupled liquid-hydrogen moderator
Beam cross section - polarized - unpolarized	 25 mm to 130 mm 60 mm by 60 mm
Beam polarization	Unpolarized and polarized beams are routinely used. Two polarization analyzers and two spin flippers are available.
Primary flight path	Target to sample position ~ 18 m
Secondary flight path	Sample to detector position ~ 0.5 to 2.5 m
Wavelength frames - with Be filter - without Be filter	 4 to < 15 Å 1 to < 11 Å
Neutron detector (reflectometry)	One-dimensional PSD on a detector arm with range of motion from -6° to 40°.
Neutron detector (diffraction)	Two-dimensional array of PSD tubes that can be placed anywhere inside the Asterix cave. Maximum scattering angle is 100°.



An intensity image of neutron-scattering data (obtained on Asterix) plotted versus scattering angle and wavelength. The arrow points to the (100) Bragg reflection that resulted from antiferromagnetic ordering in the sample.